2015 ILRS Technical Workshop

THE COPERNICUS SENTINEL-3 MISSION

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   b) Sentinels Satellite description
   c) POD requirements for Sentinels
   d) Copernicus POD Service
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3. Communication S-3 mission – ILRS
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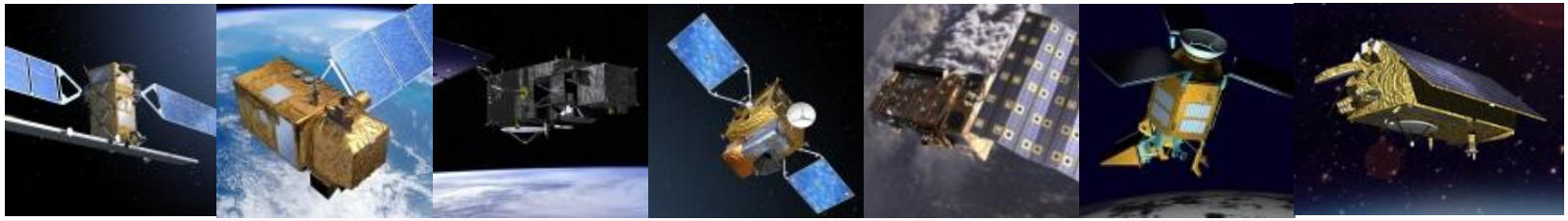
THE COPERNICUS S-3 MISSION

THE COPERNICUS PROGRAMME AND THE SENTINELS

THE COPERNICUS PROGRAMME AND THE SENTINELS – OVERVIEW

- Copernicus (http://www.copernicus.eu)
  - Former GMES (Global Monitoring for Environment and Security)
  - European Programme for the establishment of an European capacity for Earth Observation (joint EU and ESA initiative)
- ESA's Sentinels missions (http://sentinel.esa.int)
  - **Sentinel-1, -2, -3**, -4, -5, -5P, 6 (JASON CS)
  - Several units of each mission
  - Sentinel-1A launched on April 3rd, 2014
  - Sentinel-2A launched on June 22nd, 2015
  - Sentinel-3A expected to be launched on December 10th, 2015



THE COPERNICUS PROGRAMME AND THE SENTINELS – SATELLITE DESCRIPTION

	SENTINELS MISSIONS		
	Sentinel-1	**Sentinel-2**	**Sentinel-3**
Altitude	639 km	786 km	814.5 km
Inclination	98.18 deg.	98.58 deg.	98.65 deg.
Period	98.6 minutes	100.6 minutes	100.99 minutes
Cycle	12 days	10 days	27 days
Mass	2300 kg	1140 kg	1250 kg
GPS	2 GPS receivers	2 GPS receivers	2 GPS receivers
LRR	None	None	1 LRR
DORIS	None	None	1 DORIS
Attitude	Zero-Doppler + roll steering	Yaw steering	Yaw steering
Launch date	3rd April, 2014 (S1A) Expected 2016 (S1B)	23rd June, 2015 (S2A) Expected 2016 (S2B)	Exp. 10th Dec, 2015 (S3A) Expected 2017 (S3B)
Picture			

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THE COPERNICUS PROGRAMME AND THE SENTINELS – POD REQUIREMENTS

- Demanding accuracy and timeliness requirements

Mission	Category	Orbit Accuracy (RMS)
S-1	NRT	10 cm (2D)
	NTC	**5 cm (3D)**
S-2	NRT (predicted)	3 m (2D)
	NRT	1 m (3D)
S-3	NRT (S3PODIPF)	10 cm radial (target of 8 cm)
	STC	4 cm radial (target of 3 cm)
	NTC	**3 cm radial (target of 2 cm)**

Mission	Category	Latency
S-1	NRT	180 min.
	NTC	20 days
S-2	NRT (predicted)	90 min. before ANX
	NRT	**30 min.**
S-3	NRT (S3PODIPF)	**30 min.**
	STC	1.5 days
	NTC	28 days

Sentinels mission facts:

Sentinel-1:

- Two satellites
- With imaging C-band and Synthetic Aperture radars (SAR)
- 2 dual frequency GPS receivers
- S-1A launched in April 2014 (S-1B March 2016)

Sentinel-2:

- Two satellites
- With the Multi-Spectral Instrument (MSI)
- From the visible to the shortwave infrared
- 2 dual frequency GPS receivers
- S-2A launched in June 2015 (S-2B June 2016)

Sentinel-3:

- Two satellites
- Radar Altimeter
- MWR (Micro Wave Radiometer)
- 2 dual frequency GPS receivers
- A DORIS receiver
- A Laser retro-reflector for Satellite Laser Ranging (SLR)
- S-3A to be launched in December 2015 (S-3B 2017)

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THE COPERNICUS PROGRAMME AND THE SENTINELS – COPERNICUS POD SERVICE

Payload Data Ground Segment (PDGS)

- Processes the scientific data retrieved by the Sentinels
- Provider of L0 data to CPOD Service
- Recipient of products generated (from CPOD)

Sentinels Flight Operations Segment (FOS)

- Provider of FD products

External GNSS data Provider (EGP)

- Provider of high accurate / high rate GPS orbits and clocks
- Main: VERIPOS; Back-up: magicGNSS (GMV)

International Laser Ranging Service (ILRS)

- Provider of SLR data
- Recipient of CPF predictions (from CPOD)

External Auxiliary providers

- Earth Orientation Parameters and leap seconds from IERS
- Solar and magnetic activity information from NOAA
- Atmospheric gravity models from NASA

Centre National d'Études Spatiales (CNES)

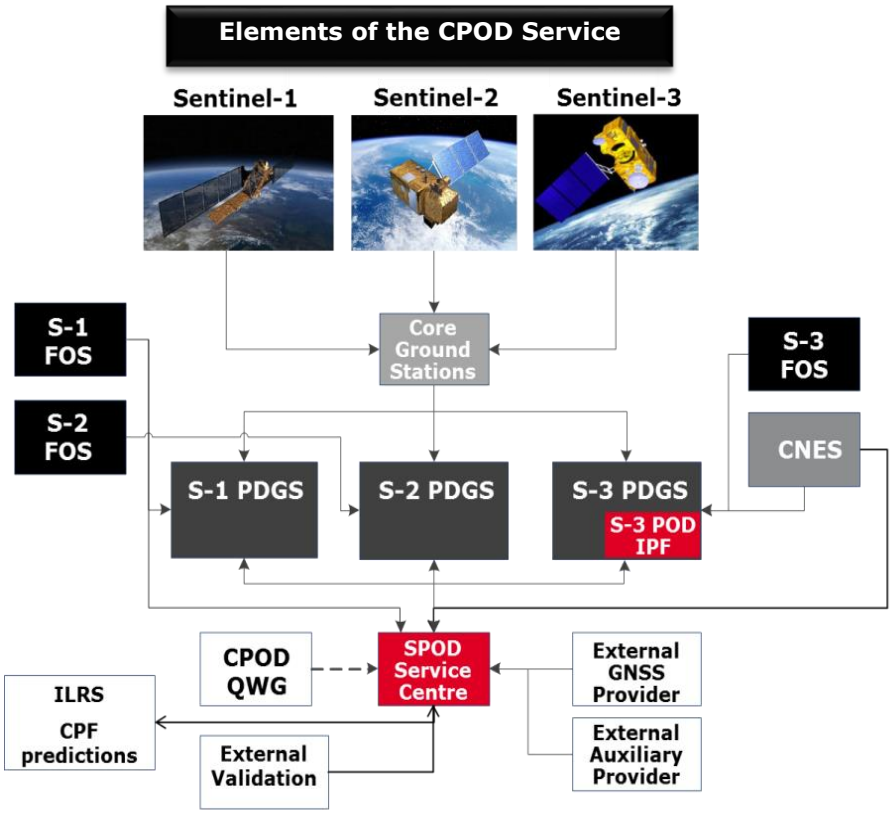
- Provider of S-3 orbital and attitude products
- Provider of DORIS data
- Recipient of RINEX observation files

External Validation

- AIUB, DLR, ESOC, TU Delft, TUM
- Provider of orbital products

CPOD Quality Working Group (CPOD QWG)

- Monitor the performance of the POD products (both the orbit products as well as the input tracking data)
- Definition of enhancements to the orbit solutions



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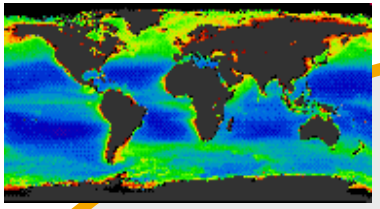
THE COPERNICUS S-3 MISSION

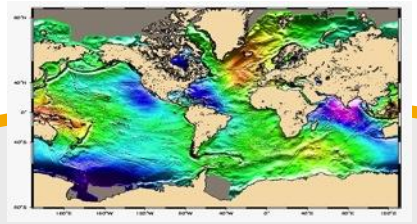
SENTINEL-3 MISSION

SENTINEL-3 MISSION – PRIMARY OBJECTIVES



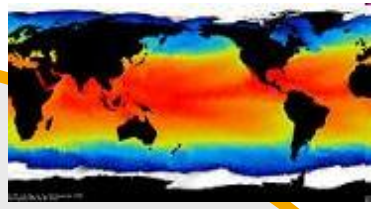
Ocean colour products

(Credit: MyOcean)



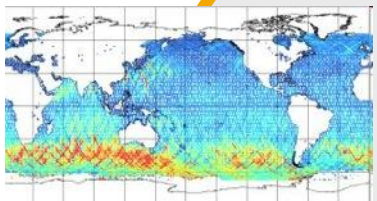
Sea Surface Height products

(Credit: CLS)



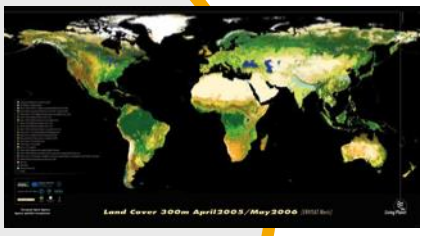
Sea Surface Temperature products

(Credit: Met Office)



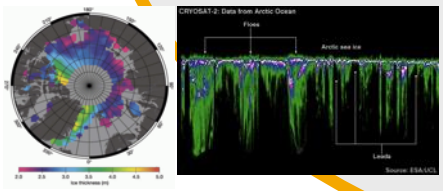
Along track wind and wave products

(Credit: AVISO)



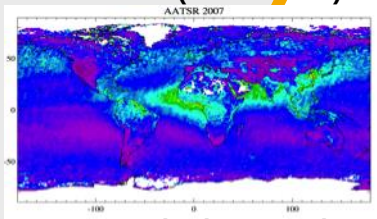
Land cover products

(Credit: ESA)



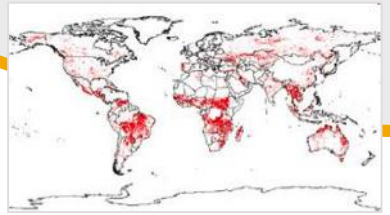
Sea Ice products

(Credit: UCL)



Atmospheric aerosol products

(Credit: GlobAerosol)



Fire products

(Credit: ESA World Fire atlas)

User parameters derived from L1b products

(Credit: GEO)

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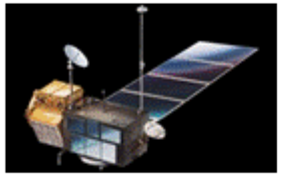
SENTINEL-3 MISSION – MISSION HERITAGE



1992: TOPEX / Poseidon-1

Poseidon-1

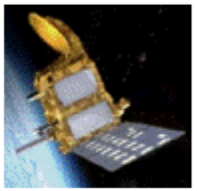
2001: JASON-1

Poseidon-2

2008: JASON-2

Poseidon-3

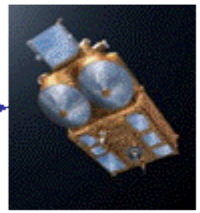
2011:AltiKa



SARAL

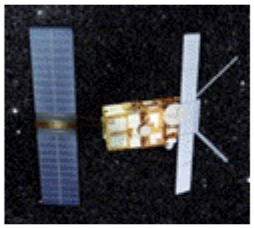
1995: CryoSat-1

SIRAL



2010: CryoSat-2

SIRAL



1992: ERS-1
1995: ERS-2

RA-1

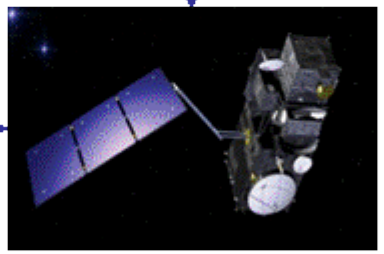
ATSR

2002: ENVISAT

RA-2

AATSR

MERIS



2013: Sentinel-3

SRAL

SLSTR

OLCI

1998: SPOT-4

Vegetation

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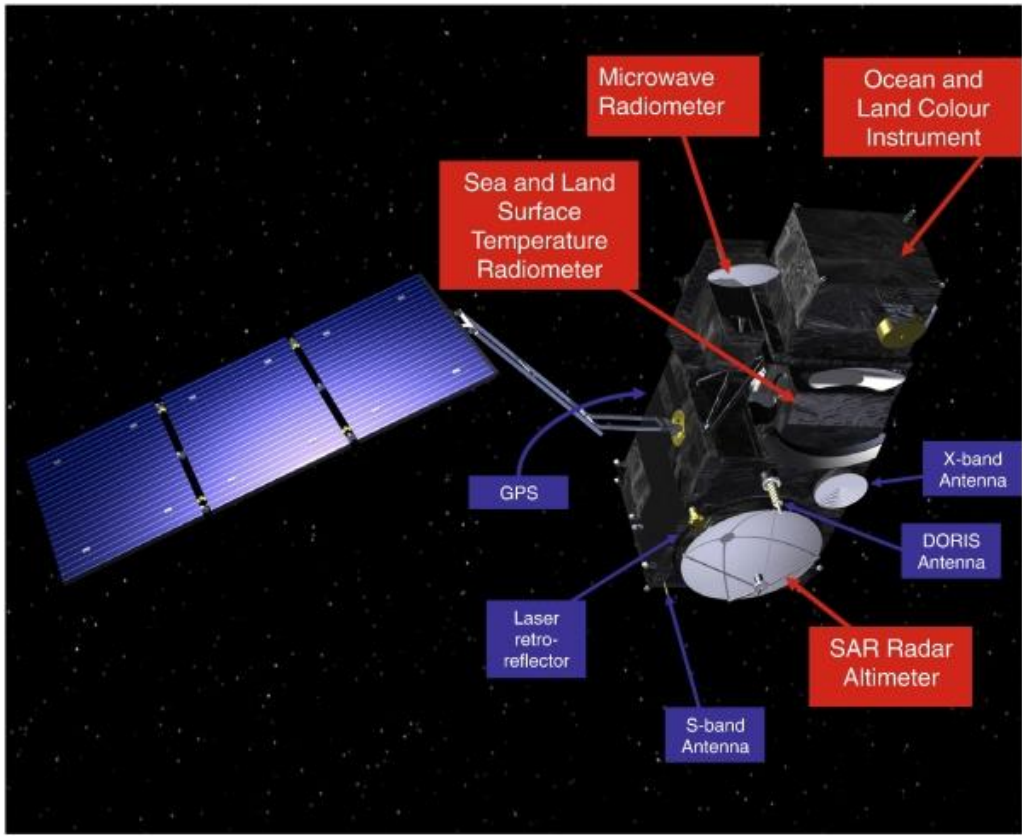
SENTINEL-3 MISSION – SATELLITE DESCRIPTION

- The spacecraft carries four main instruments:
  - **OLCI**: Ocean and Land Colour Instrument
  - **SLSTR**: Sea and Land Surface Temperature Instrument; Imager Radiometer
  - **SRAL**: SAR Radar Altimeter
  - **MWR**: MicroWave Radiometer
- Complemented by three instruments for Precise Orbit Determination:
  - **2 GPS Receivers**
  - **DORIS**
  - **LRR**



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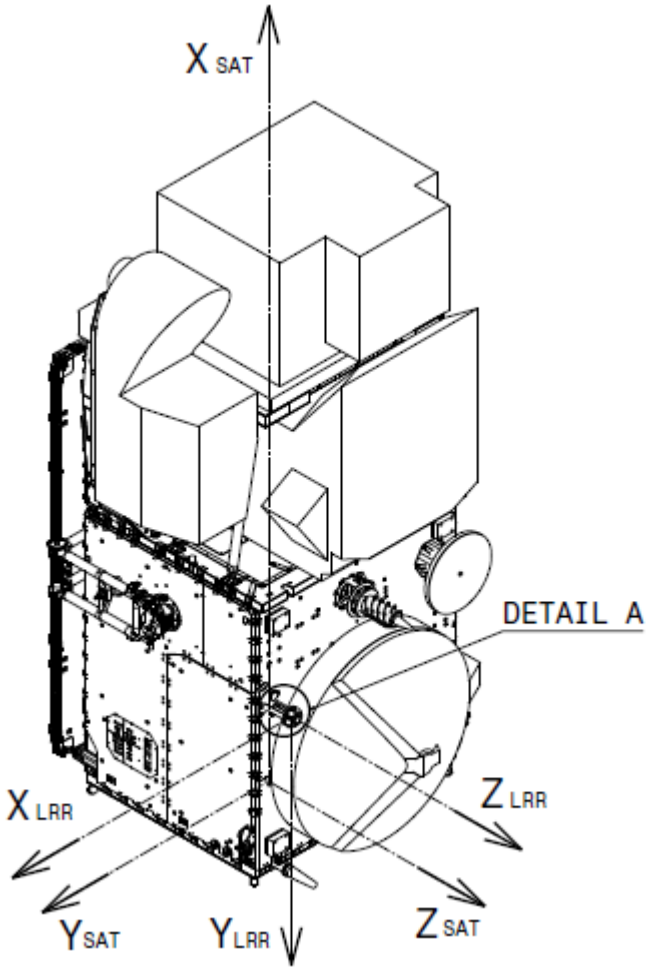
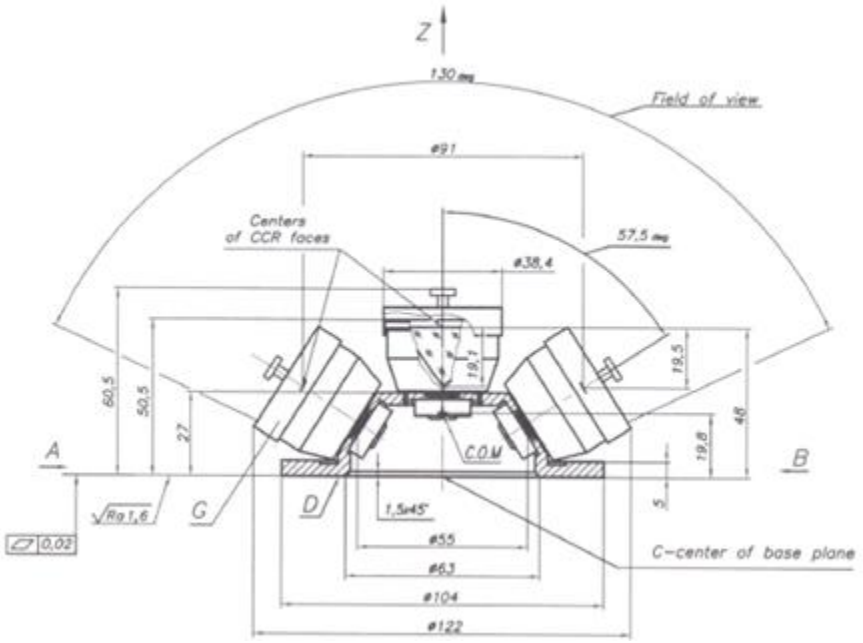
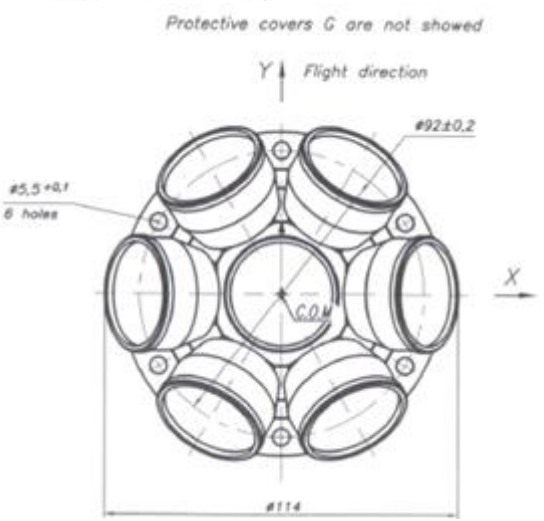
SENTINEL-3 MISSION – LRR CHARACTERISTICS

- LRR Characteristics in MSRF

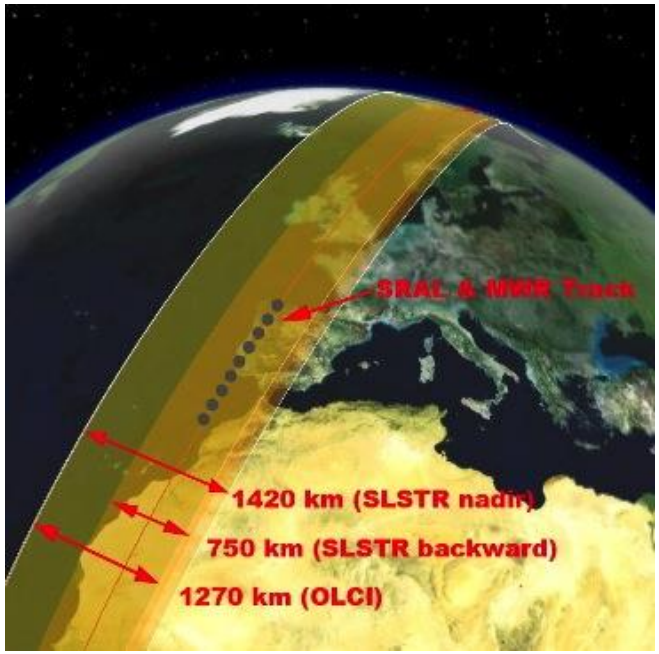


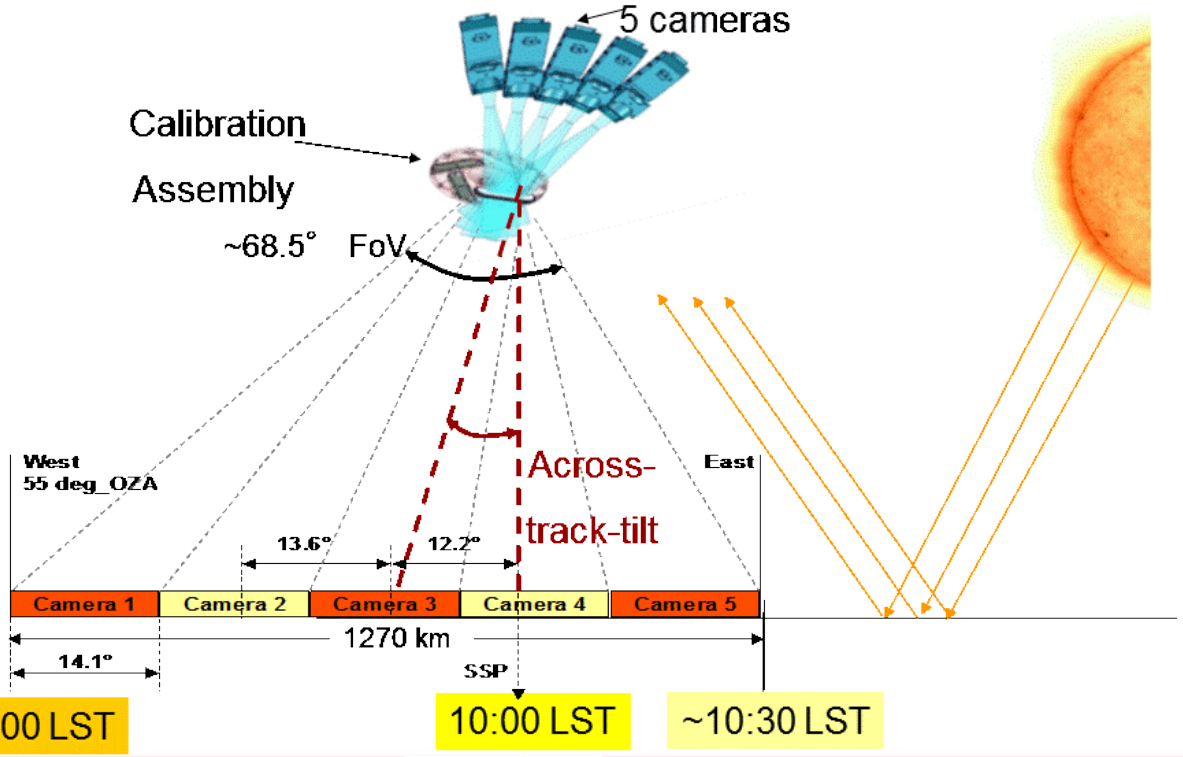




SENTINEL-3 MISSION – MISSION SUPORT REQUEST FORM - CONSTRAINTS

- The MSRF is under preparation by ESA & industry with close interaction with ILRS community
- The main complexity is to define clearly the constraints:
  - Power restrictions when SLR station is in the FoV of the OLCI instrument





THE COPERNICUS S-3 MISSION

COMMUNICATION S-3 MISSION – ILRS

COMMUNICATION S-3 MISSION – ILRS

- Sentinel-3A is expected to be launched on 10th December, 2015
- Commissioning phase spans 5 months
- Routine Operation Phase: minimum 7.5 years
- Collaboration of ILRS community in all phases is very much needed and appreciated!
  - To calibrate the GPS and DORIS biases during the commissioning phase and periodically during the routine operational phase
- Role of Copernicus POD Service
  - Point of contact for operational issues: sentinelspodops@gmv.com
  - Generate and deliver Consolidated Prediction Format (CPF) files of Sentinel-3
  - Usage of SLR observations in the STC (1 day) and NTC (28 days) POD processing to generate operational orbits for ESA
  - Update information of CoG
  - Generate GNSS Rinex observation files

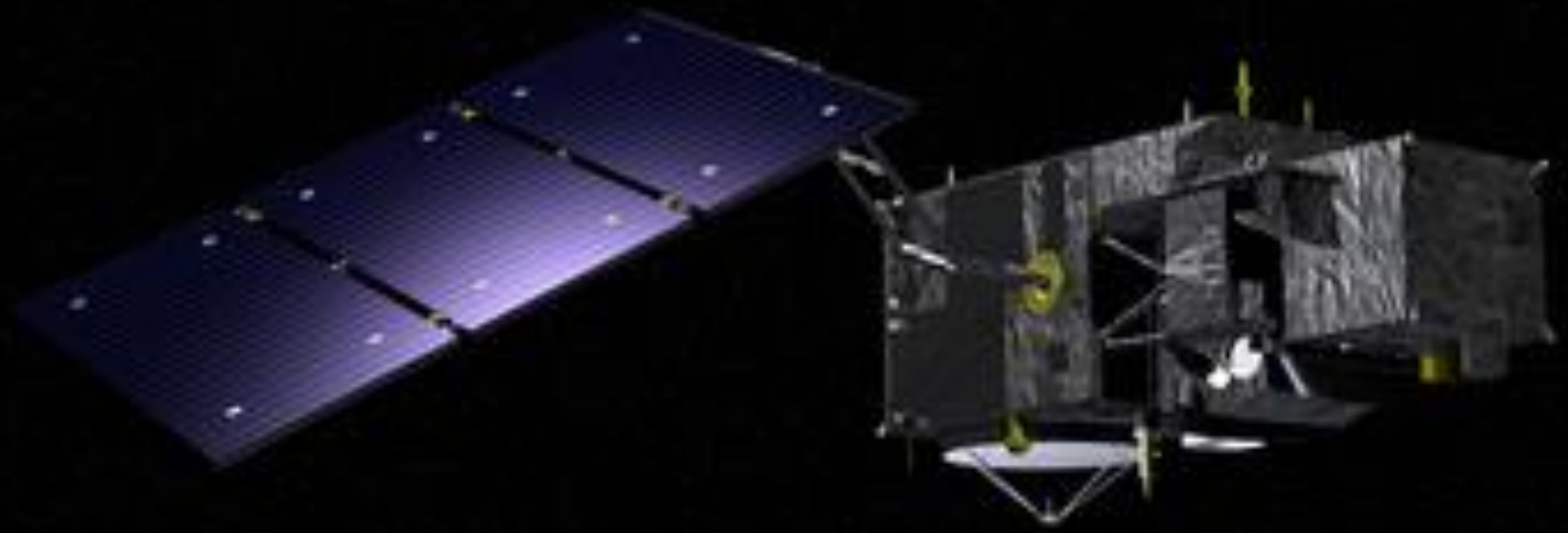
THE COPERNICUS S-3 MISSION

CONCLUSIONS

CONCLUSIONS

- Copernicus is the European operational program for the routine observation of the Earth
- The Copernicus POD Service is in charge of providing operational orbital products for ESA using GPS, SLR and DORIS observations
- Sentinel-3 is an important operational mission to continue long-term heritage of Earth observation missions
- Sentinel-3 carries a LRR for POD processing purposes
- The instrument OLCI imposes a constraint to the usage of LRR
- ESA is doing its best to deliver asap the Mission Support Request Form; ESA thanks and do count on ILRS support
- The Copernicus POD Service is in charge of delivering CPF of Sentinel-3
- The Copernicus POD Service will make use of SLR observations during the commissioning and routine phase in the processing of STC and NTC products

Thank you



Thanks ILRS for their support